BENTHIC INVERTEBRATES OF THE UPPER RUBY RIVER WATERSHED: A BIOASSESSMENT

May-June 2001

FINAL

A report to

The Montana Department of Environmental Quality
Helena, Montana

by

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April 2002

INTRODUCTION

Aquatic invertebrates are aptly applied to bioassessment since they are known to be important indicators of stream ecosystem health (Hynes 1970). Long lives, complex life cycles and limited mobility mean that there is ample time for the benthic community to respond to cumulative effects of environmental perturbations.

This report summarizes data collected in late May and June 2001 from 12 sites on seven streams in the upper Ruby River watershed, Madison County, Montana. Aquatic invertebrate assemblages were sampled by personnel of the Montana Department of Environmental Quality (DEQ). Study sites apparently lie within the Montana Valley and Foothill Prairie ecoregion (Woods et al. 1999). A multimetric approach to bioassessment such as the one applied in this study uses attributes of the assemblage in an integrated way to measure biotic health. A stream with good biotic health is " ...a balanced, integrated, adaptive system having the full range of elements and processes that are expected in the region's natural environment..." (Karr and Chu 1999). The approach designed by Plafkin et al. (1989) and adapted for use in the State of Montana has been defined as "... an array of measures or metrics that individually provide information on diverse biological attributes, and when integrated, provide an overall indication of biological condition." (Barbour et al. 1995). Community attributes that can contribute meaningfully to interpretation of benthic data include assemblage structure, sensitivity of community members to stress or pollution, and functional traits. Each metric component contributes an independent measure of the biotic integrity of a stream site; combining the components into a total score reduces variance and increases precision of the assessment (Fore et al. 1995). Effectiveness of the integrated metrics depends on the applicability of the underlying model, which rests on a foundation of three essential elements (Bollman 1998). The first of these is an appropriate stratification or classification of stream sites, typically, by ecoregion. Second, metrics must be selected based upon their ability to accurately express biological condition. Third, an adequate assessment of habitat conditions at each site to be studied is needed to assist in the interpretation of metric outcomes.

Implicit in the multimetric method and its associated habitat assessment is an assumption of correlative relationships between habitat parameters and the biotic metrics, in the absence of water quality impairment. These relationships may vary regionally, requiring an examination of habitat assessment elements and biotic metrics and a test of the presumed relationship between them. Bollman (1998) has recently studied the assemblages of the Montana Valley and Foothill Prairie ecoregion, and has recommended a battery of metrics applicable to the montane ecoregions of western Montana. This metric battery has been shown to be sensitive to impairment, related to habitat assessment parameters, and consistent over replicated samples.

Habitat assessment enhances the interpretation of biological data (Barbour and Stribling 1991), because there is generally a direct response of the biological community to habitat degradation in the absence of water quality impairment. If biotic health appears more damaged than the habitat quality would predict, water pollution by metals, other toxicants, high water temperatures, or high levels of organic and/or nutrient pollution might be suspected. On the other hand, an "artificial" elevation of biotic condition in the presence of habitat degradation may be due to the paradoxical effect of mild nutrient or organic enrichment in an oligotrophic setting.

METHODS

Aquatic invertebrates were sampled at twelve sites by Montana DEQ personnel on May 31 and June 1-20, 2001. Sample identifications are given, sites are described, and locations indicated in Table 1. The sampling method employed was that recommended in the Montana Department of Environmental Quality (DEQ) Standard Operating Procedures for Aquatic Macroinvertebrate Sampling (Bukantis 1998). In addition to aquatic invertebrate sample collection, habitat quality was visually evaluated at two of the visited sites and was reported by means of the habitat assessment protocols recommended by Bukantis (1998) for streams with riffle/run prevalence.

Aquatic invertebrate samples were delivered to Rhithron Biological Associates, Missoula, Montana, for laboratory and data analyses. In the laboratory, the Montana DEQ-recommended sorting method was used to obtain subsamples of at least 300 organisms from each sample, when possible. Organisms were identified to the lowest possible taxonomic levels consistent with Montana DEQ protocols.

Table 1. Sampling sites and dates. Twelve sites on seven streams in the upper Ruby River watershed. Sites are listed from upstream to downstream.

Site designation	Waterbody	Sampling Date	Location	
			Lat.	Long.
MF3	Middle Fork Ruby River	6/12/01	44° 51' 19" N	111° 59' 50" W
Basin1	Basin Creek	6/19/01	44° 51' 49" N	111° 59' 37" W
Basin2	Basin Creek	6/19/01	44° 51' 40" N	111° 59' 11" W
P1	Poison Creek	6/18/01	44° 52' 39" N	111° 59' 54" W
MF5	Middle Fork Ruby River	6/12/01	Near confluence with East and West Forks	
EF1	East Fork Ruby River	6/19/01	44° 54' 09" N	111° 59' 24" W
EF2	East Fork Ruby River	6/19/01	44° 54' 19" N	111° 59' 30" W
Burnt1	Burnt Creek	6/20/01	44° 56' 51" N	111° 58' 03" W
Burnt2	Burnt Creek	6/20/01	44° 56' 52" N	111° 58' 16" W
S1	Sweetwater Creek	6/01/01	45° 04' 03" N	112° 15' 55" W
S4	Sweetwater Creek	6/01/01	45° 05' 54" N	112° 12' 39" W
C3	Cottonwood Creek	5/31/01	45° 12' 18" N	112° 15' 23" W

To assess aquatic invertebrate communities in this study, a multimetric index developed in previous work for streams of western Montana ecoregions (Bollman 1998) was used. Multimetric indices result in a single numeric score, which integrates the values of several individual indicators of biologic health. Each metric used in this index was tested for its response or sensitivity to varying degrees of human influence. Correlations have been demonstrated between the metrics and various symptoms of human-caused impairment as expressed in water quality parameters or instream, streambank, and stream reach morphologic features. Metrics were screened to minimize variability over natural environmental gradients, such as site elevation or sampling season, which might confound interpretation of results (Bollman 1998). The multimetric index used in this report incorporates multiple attributes of the sampled assemblage into an integrated score that accurately describes the benthic community of each site in terms of its biologic integrity. In addition to the metrics comprising the index, other metrics, which have been shown to be applicable to biomonitoring in other regions (Kleindl 1995, Patterson 1996, Rossano 1995) were used for descriptive interpretation of results. These metrics include the number of "clinger" taxa, long-lived taxa richness, the percent of predatory organisms, and others. They are not included in the integrated bioassessment score, however, since their performance in western Montana ecoregions is unknown. However, the relationship of these metrics to habitat conditions is intuitive and reasonable.

The six metrics comprising the bioassessment index used in this study were selected because, both individually and as an integrated metric battery, they are robust at distinguishing impaired sites from relatively unimpaired sites (Bollman 1998). In addition, they are relevant to the kinds of impacts that are present in the upper Ruby River drainage. They have been demonstrated to be more variable with anthropogenic disturbance than with natural environmental gradients (Bollman 1998). Each of the six metrics developed and tested for western Montana ecoregions is described below.

1. **Ephemeroptera (mayfly) taxa richness.** The number of mayfly taxa declines as water quality diminishes. Impairments to water quality which have been demonstrated to adversely affect the ability of mayflies to flourish include elevated water temperatures, heavy metal contamination, increased turbidity, low or high pH, elevated specific conductance and toxic chemicals. Few mayfly species are able to tolerate certain disturbances to instream habitat, such as excessive sediment deposition.

2. **Plecoptera (stonefly) taxa richness.** Stoneflies are particularly susceptible to impairments that affect a stream on a reach-level scale, such as loss of riparian canopy, streambank instability, channelization, and alteration of morphological features such as pool frequency and function, riffle development and sinuosity. Just as all benthic organisms, they are also susceptible to smaller scale habitat loss, such as by sediment deposition, loss of interstitial spaces between substrate particles, or unstable substrate.

3. **Trichoptera (caddisfly) taxa richness.** Caddisfly taxa richness has been shown to decline when sediment deposition affects their habitat. In addition, the presence of certain case-building caddisflies can indicate good retention of woody debris and lack of scouring flow conditions.

4. **Number of sensitive taxa.** Sensitive taxa are generally the first to disappear as anthropogenic disturbances increase. The list of sensitive taxa used here includes organisms sensitive to a wide range of disturbances, including warmer water temperatures, organic or nutrient pollution, toxic pollution, sediment deposition, substrate instability, and others. Unimpaired streams of western Montana typically support at least four sensitive taxa (Bollman 1998).

5. **Percent filter feeders.** Filter-feeding organisms are a diverse group; they capture small particles of organic matter, or organically enriched sediment material, from the water column by means of a variety of adaptations, such as silken nets or hairy appendages. In forested montane streams, filterers are expected to occur in insignificant numbers. Their abundance increases when canopy cover is lost and when water temperatures increase and the accompanying growth of filamentous algae occurs. Some filtering organisms, specifically the Arctopsychid caddisflies (*Arctopsyche* spp. and *Parapsyche* sp.) build silken nets with large mesh sizes that capture small organisms such as chironomids and early-instar mayflies. Here they are considered predators, and, in this study, their abundance does not contribute to the percent filter feeders metric.

6. **Percent tolerant taxa.** Tolerant taxa are ubiquitous in stream sites, but when disturbance increases, their abundance increases proportionately. The list of taxa used here includes organisms tolerant of a wide range of disturbances, including warmer water temperatures, organic or nutrient pollution, toxic pollution, sediment deposition, substrate instability, and others.

Table 2. Metrics and scoring criteria for bioassessment of streams of western Montana ecoregions (Bollman 1998).

	Score			
metric	**3**	**2**	**1**	**0**
Ephemeroptera taxa richness	> 5	5 - 4	3 – 2	< 2
Plecoptera taxa richness	> 3	3 - 2	1	0
Trichoptera taxa richness	> 4	4 - 3	2	< 2
Sensitive taxa richness	> 3	3 - 2	1	0
Percent filterers	0 – 5	5.01 - 10	10.01 – 25	> 25
Percent tolerant taxa	0 – 5	5.01 - 10	10.01 – 35	> 35

Scoring criteria for each of the six metrics are presented in Table 2. Metrics differ in their possible value ranges as well as in the direction the values move as biological conditions change. For example, Ephemeroptera richness values may range from zero to ten taxa or higher. Larger values generally indicate favorable biotic conditions. On the other hand, the percent filterers metric may range from 0% to 100%; in this case, larger values are negative indicators of biotic health. To facilitate scoring, therefore, metric values were transformed into a single scale. The range of each metric has been divided into four parts and assigned a point score between zero and three. A score of three indicates a metric value similar to one characteristic of a non-impaired condition. A score of zero indicates strong deviation from non-impaired condition and suggests severe degradation of biotic health. Scores for each metric were summed to give an overall

score, the total bioassessment score, for each site in each sampling event. These scores were expressed as the percent of the maximum possible score, which is 18 for this metric battery.

The total bioassessment score for each site was expressed in terms of use-support. Criteria for use-support designations were developed by Montana DEQ and are presented in Table 3a. Scores were also translated into impairment classifications according to criteria outlined in Table 3a.

In this report, certain other metrics were used as descriptors of the benthic community response to habitat or water quality but were not incorporated into the bioassessment metric battery, either because they have not yet been tested for reliability in streams of western Montana, or because results of such testing did not show them to be robust at distinguishing impairment, or because they did not meet other requirements for inclusion in the metric battery. These metrics and their use in predicting the causes of impairment or in describing its effects on the biotic community are described below.

- The modified biotic index. This metric is an adaptation of the Hilsenhoff Biotic Index (HBI, Hilsenhoff 1987), which was originally designed to indicate organic enrichment of waters. Values of this metric are lowest in least impacted conditions. Taxa tolerant to saprobic conditions are also generally tolerant of warm water, fine sediment, and heavy filamentous algae growth (Bollman, unpublished data). Loss of canopy cover is often a contributor to higher biotic index values. The taxa values used in this report are modified to reflect habitat and water quality conditions in Montana (Bukantis 1998). Ordination studies of the benthic fauna of Montana's foothill prairie streams showed that there is a correlation between modified biotic index values and water temperature, substrate embeddedness, and fine sediment (Bollman 1998). In a study of reference streams, the average value of the modified biotic index in least-impaired streams of western Montana was 2.5 (Wisseman 1992).
- Taxa richness. This metric is a simple count of the number of unique taxa present in a sample. Average taxa richness in samples from reference streams in western Montana was 28 (Wisseman 1992). Taxa richness is an expression of biodiversity, and generally decreases with degraded habitat or diminished water quality. However, taxa richness may show a paradoxical increase when mild nutrient enrichment occurs in previously oligotrophic waters, so this metric must be interpreted with caution.
- Percent predators. Aquatic invertebrate predators depend on a reliable source of invertebrate prey, and their abundance provides a measure of the trophic complexity supported by a site. Less disturbed sites have more plentiful habitat niches to support diverse prey species, which in turn support abundant predator species.
- Number of "clinger" taxa. So-called "clinger" taxa have physical adaptations that allow them to cling to smooth substrates in rapidly flowing water. Aquatic invertebrate "clingers" are sensitive to fine sediments that fill interstices between substrate particles and eliminate habitat complexity. Animals that occupy the hyporheic zones are included in this group of taxa. Expected "clinger" taxa

richness in unimpaired streams of western Montana is at least 14 (Bollman, unpublished data).

- Number of long-lived taxa. Long-lived or semivoltine taxa require more than a year to completely develop, and their numbers decline when habitat and/or water quality conditions are unstable. They may completely disappear if channels are dewatered or if there are periodic water temperature elevations or other interruptions to their life cycles. Western Montana streams with stable habitat conditions are expected to support six or more long-lived taxa (Bollman, unpublished data).

Table 3a. Criteria for the assignment of use-support classifications / standards violation thresholds (Bukantis, 1998).

% Comparability to reference	Use support
>75	Full support--standards not violated
25-75	Partial support--moderate impairment--standards violated
<25	Non-support--severe impairment--standards violated

Table 3b. Criteria for the assignment of impairment classifications (Plafkin et al. 1989).

% Comparability to reference	Classification
> 83	nonimpaired
54-79	slightly impaired
21-50	moderately impaired
<17	severely impaired

RESULTS

Habitat assessment

Habitat assessment results for ten of the twelve sampled sites were provided; sites on Basin Creek were not evaluated. The appraisals indicate that optimal habitat conditions were perceived at the upstream site on the Middle Fork Ruby River but the downstream site was judged sub-optimal. Among the tributaries, both sites on Burnt Creek were perceived to have optimal habitat conditions, but overall habitat at sites on Poison Creek, Sweetwater Creek, and Cottonwood Creek was rated sub-optimal. On the East Fork Ruby River, the upstream site (EF-1) appeared to have marginal habitat, while the downstream site (EF-2) appeared to have sub-optimal conditions.

The upstream site on the Middle Fork Ruby River (MF-3) scored 83% of the maximal assessment score. Some sediment deposition was noted, but all other instream habitat parameters received optimal scores. Benthic substrate was reported to be composed of diverse particle sizes. Sediment inputs could have originated from streambanks, which appeared to be moderately unstable; erosion was reported to be prevalent throughout the reach. The field evaluator indicated that recent heavy rains were a possible cause of the erosion. Riparian zone width was rated sub-optimal, though field

notes suggest that riparian vegetation was vigorous and that willows exhibited good age diversity.

Moderate streambank instability was reported at the Poison Creek site. The moderate erosion of banks and slumping of outside bends may have been a source of the silt accumulations noted on channel edges, and the observed enlargement of gravel bars. Benthic substrate was scored sub-optimal, apparently because of the prevalence of boulder-sized particles; good particle size diversity was described in field notes, however. The riparian zone vegetation was described as vigorous and diverse in both structure and age.

At site MF-5, moderate deposition of sediment was observed. Point bars were particularly involved, with enlargement by large amounts of sand noted by field personnel. Instream habitat characteristics appear to have been affected somewhat by sediment deposition; although benthic substrate diversity was judged optimal, embeddedness of riffle substrates by fines was estimated at about 20%. Some large-scale channel alteration was observed; the evaluator noted that a "USFS road runs through (the) river... ". Streambanks on both sides of the channel were judged "very unstable", and vegetative protection of streambank soils was rated marginal. The riparian zone width was reported to be somewhat abbreviated. Riparian vegetation was reported to be dominated by young willows and sage.

Severe sediment deposition compromised habitat at the upstream site on the East Fork Ruby River. Field personnel described the substrate as "...boulders and large amounts of silt," with cobbles nearly completely embedded in fine sediment. Upstream of the sampled site, channels were braided. Frequent cattle and road crossings were perceived to significantly alter channel morphology. Erosion of streambanks was noted to be prevalent and severe, with "...banks sloughed off in large chunks at the sample site." The riparian zone exhibited obvious disruptions, and although width was judged to be about 30 feet, breaks occurred frequently.

At the downstream site on the East Fork, streambanks were perceived to be somewhat more stable than at the upstream site; field forms reported only moderate instability. Perhaps as a consequence, benthic substrates did not appear to be so severely affected by sediment deposition. Substrate diversity, embeddedness, and sediment deposition were each appraised as sub-optimal. Riparian conditions were described as similar to those at the upstream site; width appeared to be sub-optimal, but notable disruptions were evident.

All habitat parameters were generally scored similarly at both sites on Burnt Creek. Sediment deposition was noted to be somewhat more problematic at the downstream site, however; where cobbles were less than 10% embedded at the upper site, they were judged to be about 25% embedded at the downstream site. Field notes describe "...some sediment deposition in pools" at the upper site, but "...fines extensively deposited in pools" at the lower site. Healthy, vigorous riparian vegetation was noted, although riparian zone width was abbreviated at both sites.

Eroding and slumping streambanks were described by field personnel at the upstream site on Sweetwater Creek, and stability was appraised as poor. Sediment deposition, however, did not appear to significantly affect benthic substrate diversity or

Table 4. Stream and riparian habitat assessment for ten of the twelve sampled sites in the upper Ruby River watershed, June-July 2001. Sites are listed in an upstream-to-downstream order, and are described in Table 1.

Max. possible score	**Parameter**	MF3	Basin1	Basin2	P1	MF5	EF1
10	Riffle development	10	n.a.	n.a.	10	10	10
10	Benthic substrate	9	n.a.	n.a.	6	9	5
20	Embeddedness	17	n.a.	n.a.	16	16	2
20	Channel alteration	18	n.a.	n.a.	15	14	9
20	Sediment deposition	15	n.a.	n.a.	12	6	2
20	Channel flow status	20	n.a.	n.a.	20	20	18
20	Bank stability: left / right	5 / 5	n.a.	n.a.	5 / 5	3 / 3	1 / 1
20	Bank vegetation: left / right	9 / 9	n.a.	n.a.	9 / 9	3 / 3	5 / 5
20	Vegetated zone: left / right	8 / 8	n.a.	n.a.	8 / 8	6 / 6	6 / 6
160	Total	133	n.a.	n.a.	123	99	70
	Percent of maximum	**83**	n.a.	n.a.	**77**	**62**	**44**
	CONDITION*	**OPT**	n.a.	n.a.	**SUB**	**SUB**	**MARG**
Max. possible score	**Parameter**	EF2	Burnt1	Burnt2	S1	S4	C3
10	Riffle development	10	10	10	9	9	10
10	Benthic substrate	6	8	8	9	7	6
20	Embeddedness	12	18	15	17	11	11
20	Channel alteration	12	19	18	16	11	19
20	Sediment deposition	11	17	15	15	11	11
20	Channel flow status	16	20	18	16	12	17
20	Bank stability: left / right	5 / 5	8 / 8	9 / 9	2 / 2	1 / 1	5 / 5
20	Bank vegetation: left / right	6 / 6	9 / 9	10 / 10	9 / 9	5 / 5	8 / 8
20	Vegetated zone: left / right	6 / 6	9 / 9	8 / 8	9 / 9	7 / 7	2 / 2
160	Total	101	144	138	122	87	104
	Percent of maximum	**63**	**90**	**86**	**76**	**54**	**65**
	CONDITION*	**SUB**	**OPT**	**OPT**	**SUB**	**SUB**	**SUB**

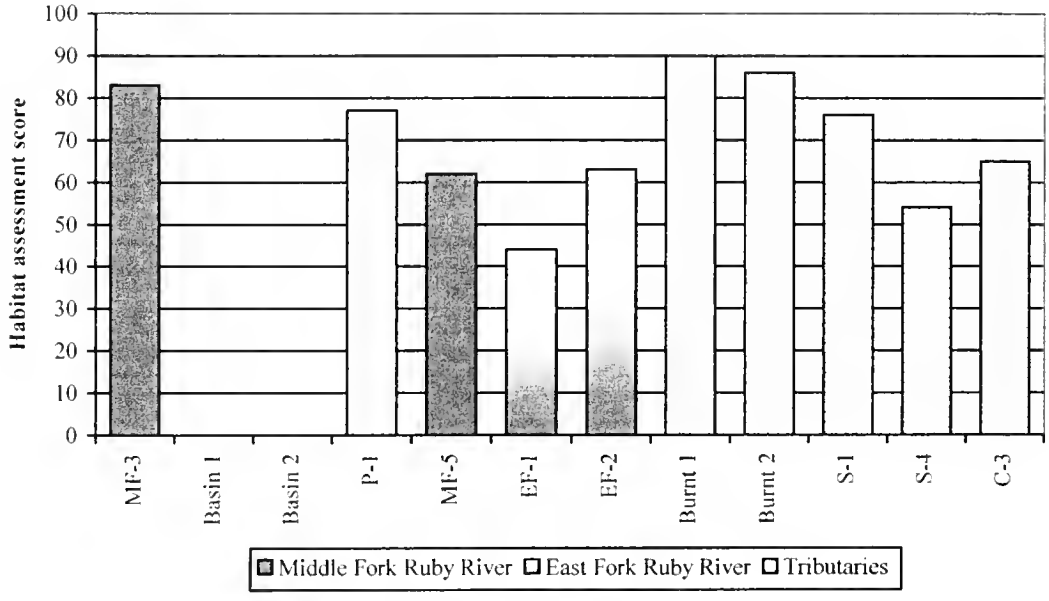
*Condition categories: Optimal (OPT) > 80% of maximum score; Sub-optimal (SUB) ; 75 - 56%; Marginal (MARG) 49 - 29%; Poor <23%. Adapted from Plafkin et al. 1998.

embeddedness in riffle habitats; both of these parameters received optimal scores. Sediment deposition in pools was reported to be slight at the sampling location. Riparian zone width received a high score although width was perceived to be abbreviated and vegetation was comprised mostly of sage, decadent willow stands, and grasses. Field notes contend that this appeared to be normal vegetation for the area.

At the downstream location on Sweetwater Creek, sediment deposition appeared to compromise benthic habitats; substrates exhibited sub-optimal diversity of particle sizes, and cobbles were 50% embedded by fines. Severe streambank instability, with sloughing of banks was noted. The riparian zone appeared to be heavily grazed, and streambank vegetation was limited to grasses, affording little stabilization. Bridges altered the natural morphology to some extent. Flow conditions were judged sub-optimal.

Moderate sediment accumulation was noted at the sampled site on Cottonwood Creek, possibly related to the moderate instability of streambanks also appraised there. Benthic substrate was described as "...some small cobbles, but mostly gravel, sand, and silt." Some embeddedness of larger substrate particles was noted as well. The riparian zone width parameter was scored "poor," although field personnel felt that the vegetation present was "normal and desirable for the area." Further comments, however, described poor age diversity of riparian willows, heavy browsing, and hedging.

Figure 1. Total habitat assessment scores for twelve sites in the upper Ruby River watershed, June-July 2001. Sites are described in Table 1.



Bioassessment

Figure 2 summarizes bioassessment scores for aquatic invertebrate communities at the twelve sites in this study. Table 5 itemizes each contributing metric and shows individual metric scores for each site. Tables 3a and 3b show criteria for impairment classifications and use-support categories recommended by Montana DEQ.

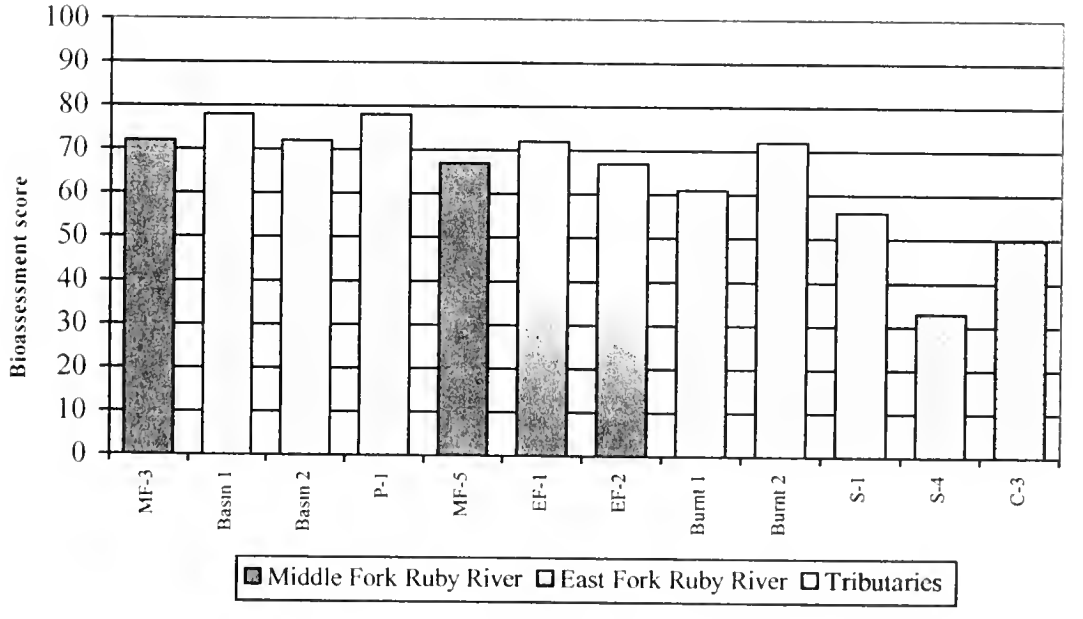
Seven of the sites in this study yielded samples with fewer than the minimum number of organisms necessary to provide reliable bioassessment results. These were Basin 1, Basin 2, P-1, MF-5, EF-1, Burnt 1, and C-3. Whether this was due to depauperate communities at the sites or to sampling bias is not clear from the data. The accuracy of results and conclusions pertinent to sites Basin 1, Basin 2, MF-5, and EF-1 should be regarded as tentative. Three samples were particularly lacking in organisms.

Thus, results and conclusions pertinent to sites P-1, Burnt 1, and C-3 are especially suspect. Bioassessment scores derived from the method used here, and in spite of low abundance of organisms in the 7 samples mentioned above, suggest that 2 of the 12 sites studied achieve full support of designated uses although there is evidence of slight impairment of biotic health. Nine sites partly support designated uses and exhibit slight impairment. The remaining site partly supports designated uses but appears to be moderately impaired.

Figure 2 illustrates the general trend of worsening bioassessment scores from upstream sites to downstream sites on both the Middle and East Forks of the Ruby River, as well as on the tributary sites from a south-to-north direction. The upstream site on the Middle Fork Ruby River (MF-3) exhibits slight impairment evident by a larger proportion than expected of filter-feeders among functional groups. In addition, the relative abundance of tolerant organisms was greater than expected. Downstream at site MF-5, similar evidence of slight impairment was present; additionally, 2 Plecoptera taxa present in the sample from the upstream site were not collected at the downstream site.

Sites on the East Fork Ruby River were also similar to each other in the evidence of impairment. The upstream site (EF-1) had a higher abundance of tolerant organisms than expected, as did its downstream correlate (EF-2). Where the upstream site had a single Plecoptera present in the sample, the downstream site did not yield any Plecoptera. Like the Middle Fork sites, both East Fork sites were appraised as slightly impaired, and partially supportive of designated uses.

Figure 2. Total bioassessment scores for twelve sites in the upper Ruby River watershed, June-July 2001. Sites are described in Table 1. The evaluations are based on the revised bioassessment metric battery (Bollman 1998).



Both Basin Creek sites yielded samples with fewer Plecoptera taxa and fewer sensitive taxa than expected. While the upper site (Basin 1) fully supported designated uses, conditions there supported a population of filter-feeders that was somewhat more abundant than expected. At the lower site (Basin 2), the proportion of filter-feeders was more appropriate, but the bioassessment score was depressed by the large proportion of tolerant organisms present in the sample. The lower site only partly supported uses.
No single bioassessment metric performed especially poorly at the single site on Poison Creek (P-1); slight impairment was evident by slightly fewer Ephemeroptera taxa and Plecoptera taxa than expected, and a somewhat elevated proportion of tolerant organisms. Despite this evidence of slight impairment, the site fully supported designated uses.

Sites on Burnt Creek were both characterized by much larger proportions of tolerant animals than expected. Like many of the other sites visited for this study, these locations also supported low Plecoptera taxa richness compared to reference conditions.

The greatest difference between upstream and downstream bioassessment scores among the streams in this study occurred on Sweetwater Creek. Slight impairment of biotic health at the upper site (S-1) deteriorated to moderate impairment at the lower site (S-4). No Plecoptera taxa were collected at the upper site, fewer sensitive taxa were present than expected, and the site supported abundant tolerant animals. By contrast, site S-4 appeared to lack Ephemeroptera as well as Trichoptera taxa. Not a single sensitive organism was taken in the sample. While the abundance of tolerant organisms was appropriate, somewhat greater numbers of filter-feeders than expected were present.

Slight impairment of biotic health and partial support of designated uses was suggested by the bioassessment score calculated for the single site on Cottonwood Creek (C-3) studied here. Numbers of Ephemeroptera and Trichoptera taxa were lower than expected, and the proportion of tolerant organisms was higher than expected.

Aquatic invertebrate communities

Measures reflecting water quality performed positively at both sites on the Middle Fork Ruby River. Six mayfly taxa were collected at the uppermost site (MF-3), including the sensitive ephemerellid *Drunella grandis*. The modified biotic index value calculated for the sampled assemblage was 4.13, perhaps slightly elevated over expectations, but not as convincing a finding as the rich mayfly fauna. Eight mayfly taxa were taken at the lower site (MF-5), and the modified biotic index (3.89) was within expected limits for a foothill stream. At both sites, filter-feeders were more preponderant than expected, suggesting that fine particulates in suspension were plentiful. Tolerant taxa were more abundant than expected at both sites, however, in both cases, tolerant animals were nearly all elmid beetles *Optioservus* sp. and *Zaitzevia* sp., which together comprised 13% of the assemblages collected at each site. These animals are ubiquitous, and may be gregarious in habit, implying that collecting them in large numbers in a sample may be a fortuitous event, and not necessarily reflective of degraded habitat or water quality conditions. Ample numbers of "clingers" were present in both samples (14 at MF-3 and 15 at MF-5); this finding, together with rich caddisfly faunas, suggests that fine sediment deposition did not appreciably impair hard substrate habitats. At the lower site, only 3 stonefly taxa were present in the sample, and none were abundant, suggesting that large-scale features influence biota at the site. Such features might be streambank instability, loss of riparian

Table 5. Metric values, scores, and bioassessments for sites in the upper Ruby River watershed, June-July 2001. Sites are described in Table 1. Assessment classifications and use support designations in parentheses are tentative, since they are based on samples with inadequate numbers of organisms. The revised bioassessment metric battery (Bollman 1998) was used in the evaluation.

	SITES											
	MF3	Basin1	Basin2	P1	MF5	EF1	EF2	Burnt1	Burnt2	S1	S4	C3
METRICS	**METRIC VALUES**											
Ephemeroptera richness	6	6	6	5	8	9	9	9	6	4	1	3
Plecoptera richness	5	1	1	2	3	1	0	1	2	0	1	3
Trichoptera richness	5	7	9	6	5	8	7	4	6	9	0	1
Number of sensitive taxa	2	2	3	2	2	3	3	3	2	1	0	2
Percent filterers	24	7	1	0	14	0	0	2	1	1	7	0
Percent tolerant taxa	14	2	25	8	14	31	15	44	57	26	3	25
	METRIC SCORES											
Ephemeroptera richness	3	3	3	2	3	3	3	3	3	2	0	1
Plecoptera richness	3	1	1	2	2	1	0	1	2	0	1	2
Trichoptera richness	3	3	3	3	3	3	3	2	3	3	0	0
Number of sensitive taxa	2	2	2	2	2	2	2	2	2	1	0	2
Percent filterers	1	2	3	3	1	3	3	3	3	3	2	3
Percent tolerant taxa	1	3	1	2	1	1	1	0	0	1	3	1
TOTAL SCORE (max.=18)	**13**	**14**	**13**	**14**	**12**	**13**	**12**	**11**	**13**	**10**	**6**	**9**
PERCENT OF MAX.	72	(78)	(72)	(78)	(67)	(72)	67	(61)	72	56	33	(50)
Impairment classification*	**SLI**	**(SLI)**	**(SLI)**	**(SLI)**	**(SLI)**	**(SLI)**	**SLI**	**(SLI)**	**SLI**	**SLI**	**MOD**	**(SLI)**
USE SUPPORT †	**PART**	**(FULL)**	**(PART)**	**(FULL)**	**(PART)**	**(PART)**	**PART**	**(PART)**	**PART**	**PART**	**PART**	**(PART)**

* Classifications: (NON) non-impaired, (SLI) slightly impaired, (MOD) moderately impaired, (SEV) severely impaired. See Table 3a.
† Use support designations: See Table 3b.

canopy, channel widening; even landscape characteristics not related to human disturbance could be involved.

The benthic assemblages of Basin Creek suggest good water quality, since 6 mayfly taxa were found at both sites. The moderately elevated biotic index values (4.53 at Basin 1 and 4.65 at Basin 2), however, seem to indicate mild impairment of water quality. At the upstream site (Basin 1) water quality impairment is not evident in the taxonomic composition of the sampled assemblage. The dominant taxon, the midge *Micropsectra* sp., is assigned a high tolerance value; it's abundance in the sample may only indicate that a slack water habitat was included in the sampling effort. Since this midge comprised 22% of organisms in the sample, its high biotic index designation appears to have greatly influenced the calculated biotic index value. At the lower site, however, the high biotic index value appears to reflect thermal conditions; the dominant taxon here was the caddisfly *Helicopsyche borealis*, which prefers warmer water. This taxon comprised 20% of organisms collected at the site, and influenced the performance of the Percent Tolerant Taxa metric as well. At both sites, only a single stonefly taxon was collected; this was the sensitive perlodid *Kogotus* sp. At both Basin Creek sites, high taxa richness (33 at Basin 1 and 34 at Basin 2), and high diversity and proportion of predatory taxa suggest good instream habitat with abundant niches. "Clinger" taxa and caddisfly taxa were also plentiful at both sites, implying that fine sediments did not appreciably alter hard substrate availability.

Low abundance of organisms in the sample collected at the Poison Creek site limit the observations and hypotheses that can be made based on its composition. However, 5 mayfly taxa were taken, suggesting that water quality was no more than mildly impaired, if it were impaired at all. Six caddisfly taxa and 12 "clinger" taxa were present in the sample, suggesting that fine sediment deposition was not much of a problem at the Poison Creek site visited.

Water quality indicators performed exceptionally well at both sites on the East Fork Ruby River; modified biotic index values (3.24 at EF-1 and 2.66 at EF-2) calculated for these sites were the lowest among sites studied. In addition, 9 mayfly taxa were present in each of the 2 samples analyzed. Both sites supported populations of the sensitive ephemerellid *Drunella doddsi*. Cold water of good quality is suggested. Rapid flow conditions may be indicated by the dearth of chironomids at both sites. Only 12 individuals in 4 taxa were collected at the upper site (EF-1); 3 individuals in 2 taxa were collected at the lower site (EF-2). Other factors, such as sampling bias may account for this finding, however. A rich collection of "clinger" taxa and caddisfly taxa suggest that fine sediments were not excessively deposited at either site. Low stonefly taxa richness, which appeared to be a ubiquitous condition among the sites in this study, was also apparent in the East Fork Ruby River.

Low abundance of organisms in the sample collected at the upper site on Burnt Creek (Burnt 1) precludes confidence in most observations that could be made concerning the site. One thing that can be noted, however, is that the 9 mayfly taxa taken there suggest that water quality was not impaired. The mayfly fauna included 2 sensitive taxa: *Drunella doddsi* and *Drunella spinifera*. A large number of "clinger" taxa were present in the sample, suggesting that substrates were unimpacted by fine sediment deposition. The number of organisms collected at the lower site (Burnt 2) was adequate for analysis. Mayfly taxa richness (6) suggests good water quality at this site, although

the modified biotic index value (4.92) was higher than expected. The dominant taxon in the sample was the ubiquitous tolerant mayfly *Baetis tricaudatus*, which comprised 55% of organisms. The abundance of this animal accounts for the high proportion of tolerant taxa, and the low score associated with that metric. Mild water quality impairment is probably indicated by these findings; the impairment could be due to nutrient and/or organic pollution. Fifteen "clinger" taxa and 6 caddisfly taxa were present in the sample, suggesting that cobble surfaces lacked fine sediment deposition.

Taxa richness (37) at the upper Sweetwater Creek site (S-1) was higher than at any other site visited for this study. Seven predator taxa were present. These findings suggest diverse instream habitats at this site. Benthic substrate is probably free of significant fine sediment deposition, since 9 caddis fly taxa were collected as well as 12 "clinger" taxa. Water quality impairment, possibly due to nutrients and/or organic pollution, appears to affect the benthic community composition, however. The modified biotic index value was 4.74, and only 4 mayfly taxa were present in the sample. Mild enrichment may have enhanced taxa richness; this phenomenon is sometimes called the "nutrient paradox." The downstream site on Sweetwater Creek received the lowest bioassessment score among the sites studied. Among the 17 taxa present in the sample, 10 taxa, representing 87% of organisms, were chironomids. A single mayfly taxon was collected, and the modified biotic index value (5.95) was the highest calculated for any site in this study. These findings suggest poor water quality, perhaps impaired by nutrient pollution and/or elevated water temperature. No caddis fly taxa were collected and there was a dearth of "clinger" taxa among the sampled organisms, suggesting that fine sediment deposition may obliterate some instream habitats. Further evidence of monotonous habitats can be found in the low taxa richness, and the presence of only 4 predator taxa.

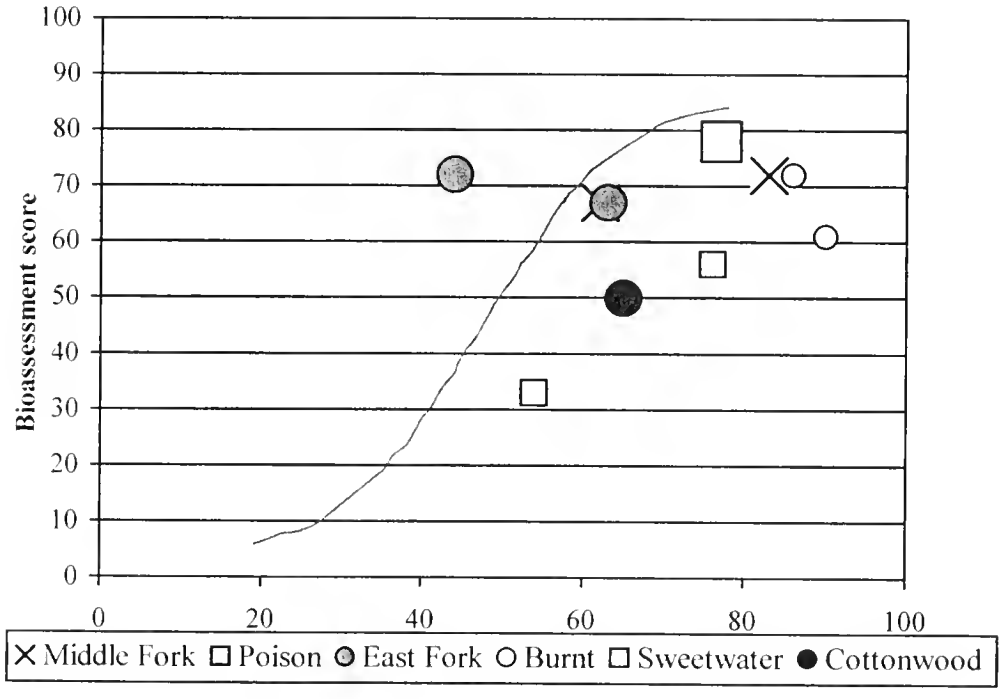
The sample taken at the site on Cottonwood Creek contained too few organisms for effective analysis. No richness metric performed well. It is unclear whether the low abundance of organisms represents actual conditions at the site or whether it could be attributed to sampling bias.

CONCLUSIONS

- For the sites located above Sweetwater Creek, there was a remarkably small range of bioassessment scores (67-78), and low stonefly taxa richness was common to all save the most upstream site in the drainage. These findings suggest that the slight impairment implied by these scores may be attributable to basin-wide geographic or geologic features of the landscape. Low stonefly taxa richness is often related to large-scale disturbances; whether or not the features are related to human disturbance or to natural processes is not apparent from these data alone.
- Low abundance of organisms in some samples prevented reliable bioassessment of some sites. It was unclear whether the low numbers of animals was due to conditions at the stream site or to sampling procedures. Low abundance of organisms at sites could be due to natural conditions, such as torrential flow or other factors, or to anthropogenic disturbances, such as degraded water and/or habitat quality.

- Middle Fork Ruby River sites and the upper site on Basin Creek (Basin 1) exhibited evidence of good water quality and unimpaired habitat. Fine organic matter in suspension appeared to be plentiful at these sites.
- Taxonomic composition of the benthic assemblage collected at the lower Basin Creek site (Basin 2) suggests warm water temperatures, but good habitat conditions.
- Low sample abundance makes observations about the benthic assemblage at Poison Creek uncertain. However, high mayfly taxa richness, and high caddis fly taxa richness seem to indicate good water quality and unimpaired habitat conditions at the studied site.
- Good habitat conditions and water quality are indicated by the composition of samples taken at both East Fork Ruby River sites.
- Low sample abundance makes observations about the benthic assemblage at the upper site on Burnt Creek (Burnt 1) uncertain. However, high mayfly taxa richness and ample caddisfly taxa seem to indicate good water quality and habitat conditions at that site. Mild water quality impairment may limit biotic health at the lower site on Burnt Creek (Burnt 2).
- Biotic health appears to deteriorate from the upper site (S-1) to the lower site (S-4) on Sweetwater Creek. The lower site appears to be impacted by sediment deposition and by degraded water quality, perhaps due to nutrient pollution or elevated water temperatures or both.
- Low abundance of organisms and poor performance of richness metrics preclude reliable observations about conditions at the Cottonwood Creek site.
- The relationship between habitat assessment scores and bioassessment scores for sites in this study is illustrated in Figure 3. The red curve in the center of the graph represents the hypothetical relationship between habitat quality and biotic health when habitat degradation is the sole source of impairment to benthic assemblage health (Barbour and Stribling 1991). The graph suggests that symbols falling to the right and below the red line represent sites where bioassessment scores were lower than expected given the assessed habitat quality. This implies that water quality may have been impaired at these sites.

Figure 3. The relationship of habitat assessment scores and bioassessment scores for 10 sites in the upper Ruby River watershed, June-July 2001. The red curve represents the hypothetical relationship between habitat scores and bioassessment scores if habitat quality solely determined biotic health.



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APPENDIX

Taxonomic data and summaries

The upper Ruby River watershed

May-June, 2001

Aquatic Invertebrate Taxonomic Data

Site Name: M F Ruby River
Site ID: MF-3 6/12/01

Approx. percent of sample used: 20

Taxon	Quantity	Percent	HBI	FFG
Sphaeriidae	1	0.33	8	CG
Acari	2	0.66	5	PA
Total Misc. Taxa	**3**	**0.99**		
Acentrella turbida	1	0.33	4	CG
Baetis tricaudatus	1	0.33	6	CG
Drunella grandis	3	0.99	2	CG
Ephemerella sp.	7	2.31	1	CG
Cinygmula sp.	26	8.58	4	SC
Epeorus longimanus	12	3.96	1	SC
Total Ephemeroptera	**50**	**16.50**		
Triznaka sp.	2	0.66	0	PR
Suwallia sp.	1	0.33	0	PR
Hesperoperla pacifica	2	0.66	2	PR
Isoperla sp.	5	1.65	2	PR
Kogotus sp.	1	0.33	2	PR
Total Plecoptera	**11**	**3.63**		
Amiocentrus aspilus	1	0.33	3	CG
Brachycentrus americanus	15	4.95	1	OM
Helicopsyche borealis	3	0.99	7	SC
Lepidostoma sp.-sand case larvae	16	5.28	1	SH
Neophylax splendens	1	0.33	2	SC
Total Trichoptera	**36**	**11.88**		
Optioservus sp.	3	0.99	4	SC
Zaitzevia sp.	36	11.88	4	CG
Total Coleoptera	**39**	**12.87**		
Ceratopogoninae	1	0.33	6	PR
Chelifera sp.	5	1.65	6	PR
Simulium sp.	22	7.26	6	CF
Antocha sp.	7	2.31	3	CG
Hexatoma sp.	11	3.63	2	PR
Total Diptera	**46**	**15.18**		
Diamesa sp.	1	0.33	5	CG
Eukiefferiella Brehmi Gr.	7	2.31	4	OM
Microtendipes sp.	1	0.33	6	CG
Orthocladius sp.	50	16.50	6	CG
Pagastia sp.	7	2.31	1	CG
Parametriocnemus sp.	1	0.33	5	CG
Potthastia sp.	1	0.33	2	CG
Tanytarsus sp.	50	16.50	6	CF
Total Chironomidae	**118**	**38.94**		
Grand Total	**303**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: M F Ruby River **Site ID: MF-3 6/12/01**

TOTAL ABUNDANCE	303
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	97
TOTAL NUMBER OF TAXA	33
Number EPT taxa	16

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	2	3	0.99
Odonata	0	0	0.00
Ephemeroptera	6	50	16.50
Plecoptera	5	11	3.63
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	5	36	11.88
Lepidoptera	0	0	0.00
Coleoptera	2	39	12.87
Diptera	5	46	15.18
Chironomidae	8	118	38.94

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	0.82

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	8	28	9.24
Parasite	1	2	0.66
Collector-gatherer	14	118	38.94
Collector-filterer	2	72	23.76
Macrophyte-herbivore	0	0	0.00
Piercer-herbivore	0	0	0.00
Scraper	5	45	14.85
Shredder	1	16	5.28
Xylophage	0	0	0.00
Omnivore	2	22	7.26
Unknown	0	0	0.00

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	0.63
Scraper/(Scraper + C.filterer)	0.38
Shredder/Total organisms	0.02

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Orthocladius sp.	50	16.50
Tanytarsus sp.	50	16.50
Zaitzevia sp	36	11.88
Cinygmula sp.	26	8.58
Simulium sp.	22	7.26
SUBTOTAL 5 DOMINANTS	184	60.73
Lepidostoma sp.-sand case larv.	16	5.28
Brachycentrus americanus	15	4.95
Epeorus longimanus	12	3.96
Hexatoma sp.	11	3.63
Ephemerella sp.	7	2.31
TOTAL DOMINANTS	238	78.55

SAPROBIC INDICES

Hilsenhoff Biotic Index	4.13

DIVERSITY MEASURES

Shannon H (loge)	2.39
Shannon H (log2)	3.45
Evenness	0.68
Simpson D	0.08

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	92	30.36
Univoltine	155	50.99
Semivoltine	57	18.65

	#TAXA	ABUNDANCE	PERCENT
Tolerant	4	43	14.19
Intolerant	1	1	0.33
Clinger	14	187	61.72

Aquatic Invertebrate Taxonomic Data

Site Name: Basin Creek
Site ID: B-1 6/20/01

Approx. percent of sample used: 60

Taxon	Quantity	Percent	HBI	FFG
Sphaeriidae	2	0.71	8	CG
Acari	3	1.06	5	PA
Total Misc. Taxa	**5**	**1.77**		
Acentrella turbida	8	2.84	4	CG
Baetis tricaudatus	3	1.06	6	CG
Drunella spinifera	1	0.35	0	PR
Ephemerella sp.	2	0.71	1	CG
Cinygmula sp.	6	2.13	4	SC
Epeorus longimanus	3	1.06	1	SC
Total Ephemeroptera	**23**	**8.16**		
Kogotus sp.	2	0.71	2	PR
Total Plecoptera	**2**	**0.71**		
Amiocentrus aspilus	37	13.12	3	CG
Brachycentrus americanus	26	9.22	1	OM
Micrasema sp.	5	1.77	1	MH
Helicopsyche borealis	1	0.35	7	SC
Ochrotrichia sp.	1	0.35	4	PH
Lepidostoma sp.-panel case larvae	1	0.35	1	SH
Dicosmoecus gilvipes	1	0.35	2	SC
Total Trichoptera	**72**	**25.53**		
Oreodytes sp.	1	0.35	5	PR
Heterlimnius sp.	3	1.06	4	CG
Total Coleoptera	**4**	**1.42**		
Chelifera sp.	1	0.35	6	PR
Prosimulium sp.	1	0.35	3	CF
Simulium sp.	19	6.74	6	CF
Tabanidae	1	0.35	8	PR
Antocha sp.	10	3.55	3	CG
Hexatoma sp.	12	4.26	2	PR
Tipula sp.	1	0.35	4	OM
Total Diptera	**45**	**15.96**		
Cricotopus Bicinctus Gr.	2	0.71	7	CG
Eukiefferiella Gracei Gr.	3	1.06	4	OM
Micropsectra sp.	61	21.63	7	CG
Orthocladius sp.	52	18.44	6	CG
Pagastia sp.	8	2.84	1	CG
Parametriocnemus sp.	1	0.35	5	CG
Thienemannimyia Gr.	3	1.06	6	PR
Tvetenia sp.	1	0.35	5	CG
Total Chironomidae	**131**	**46.45**		
Grand Total	**282**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Basin Creek **Site ID: B-1 6/20/01**

TOTAL ABUNDANCE	282
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	97
TOTAL NUMBER OF TAXA	33
Number EPT taxa	14

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	2	5	1.77
Odonata	0	0	0.00
Ephemeroptera	6	23	8.16
Plecoptera	1	2	0.71
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	7	72	25.53
Lepidoptera	0	0	0.00
Coleoptera	2	4	1.42
Diptera	7	45	15.96
Chironomidae	8	131	46.45

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	0.74

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	7	21	7.45
Parasite	1	3	1.06
Collector-gatherer	13	190	67.38
Collector-filterer	2	20	7.09
Macrophyte-herbivore	1	5	1.77
Piercer-herbivore	1	1	0.35
Scraper	4	11	3.90
Shredder	1	1	0.35
Xylophage	0	0	0.00
Omnivore	3	30	10.64
Unknown	0	0	0.00

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	0.55
Scraper/(Scraper + C.filterer)	0.35
Shredder/Total organisms	0.00

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Micropsectra sp.	61	21.63
Orthocladius sp.	52	18.44
Amiocentrus aspilus	37	13.12
Brachycentrus americanus	26	9.22
Simulium sp.	19	6.74
SUBTOTAL 5 DOMINANTS	195	69.15
Hexatoma sp.	12	4.26
Antocha sp.	10	3.55
Acentrella turbida	8	2.84
Pagastia sp.	8	2.84
Cinygmula sp.	6	2.13
TOTAL DOMINANTS	239	84.75

SAPROBIC INDICES

Hilsenhoff Biotic Index	4.53

DIVERSITY MEASURES

Shannon H (loge)	2.23
Shannon H (log2)	3.22
Evenness	0.64
Simpson D	0.10

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	110	39.10
Univoltine	140	49.73
Semivoltine	32	11.17

	#TAXA	ABUNDANCE	PERCENT
Tolerant	5	7	2.48
Intolerant	1	2	0.71
Clinger	15	119	42.20

Aquatic Invertebrate Taxonomic Data

Site Name: Basin Creek
Site ID: B-2 6/20/01

Approx. percent of sample used: 100

Taxon	Quantity	Percent	HBI	FFG
Nematoda	1	0.37	5	PA
Sphaeriidae	4	1.50	8	CG
Acari	2	0.75	5	PA
Total Misc. Taxa	**7**	**2.62**		
Baetis tricaudatus	3	1.12	6	CG
Drunella grandis	1	0.37	2	CG
Ephemerella sp.	1	0.37	1	CG
Cinygmula sp.	26	9.74	4	SC
Epeorus longimanus	1	0.37	1	SC
Paraleptophlebia sp.	1	0.37	4	CG
Total Ephemeroptera	**33**	**12.36**		
Kogotus sp.	8	3.00	2	PR
Total Plecoptera	**8**	**3.00**		
Amiocentrus aspilus	15	5.62	3	CG
Brachycentrus americanus	1	0.37	1	OM
Micrasema sp.	7	2.62	1	MH
Helicopsyche borealis	54	20.22	7	SC
Ochrotrichia sp.	1	0.37	4	PH
Lepidostoma sp.-sand case larvae	2	0.75	1	SH
Rhyacophila Angelita Gr.	8	3.00	0	PR
Rhyacophila Brunnea Gr.	6	2.25	1	PR
Neophylax splendens	2	0.75	2	SC
Total Trichoptera	**96**	**35.96**		
Optioservus sp.	3	1.12	4	SC
Zaitzevia sp.	4	1.50	4	CG
Total Coleoptera	**7**	**2.62**		
Chelifera sp.	2	0.75	6	PR
Prosimulium sp.	1	0.37	3	CF
Simulium sp.	2	0.75	6	CF
Caloparyphus sp.	1	0.37	5	CG
Antocha sp.	24	8.99	3	CG
Hexatoma sp.	14	5.24	2	PR
Total Diptera	**44**	**16.48**		
Corynoneura sp.	1	0.37	7	CG
Cricotopus nostococladius	1	0.37	3	PH
Eukiefferiella Devonica Gr.	8	3.00	4	OM
Eukiefferiella Gracei Gr.	4	1.50	4	OM
Micropsectra sp.	36	13.48	7	CG
Orthocladius sp.	21	7.87	6	CG
Thienemanniella sp.	1	0.37	6	CG
Total Chironomidae	**72**	**26.97**		
Grand Total	**267**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Basin Creek **Site ID: B-2 6/20/01**

TOTAL ABUNDANCE	267
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	137
TOTAL NUMBER OF TAXA	34
Number EPT taxa	16

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	3	7	2.62
Odonata	0	0	0.00
Ephemeroptera	6	33	12.36
Plecoptera	1	8	3.00
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	9	96	35.96
Lepidoptera	0	0	0.00
Coleoptera	2	7	2.62
Diptera	6	44	16.48
Chironomidae	7	72	26.97

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	1 90

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	5	38	14 23
Parasite	2	3	1 12
Collector-gatherer	13	113	42.32
Collector-filterer	2	3	1.12
Macrophyte-herbivore	1	7	2.62
Piercer-herbivore	2	2	0.75
Scraper	5	86	32.21
Shredder	1	2	0.75
Xylophage	0	0	0.00
Omnivore	3	13	4.87
Unknown	0	0	0.00

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	28.67
Scraper/(Scraper + C.filterer)	0.97
Shredder/Total organisms	0.00

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Helicopsyche borealis	54	20.22
Micropsectra sp	36	13.48
Cinygmula sp.	26	9.74
Antocha sp.	24	8.99
Orthocladius sp.	21	7.87
SUBTOTAL 5 DOMINANTS	161	60.30
Amiocentrus aspilus	15	5.62
Hexatoma sp.	14	5.24
Kogotus sp.	8	3.00
Rhyacophila Angelita Gr.	8	3.00
Eukiefferiella Devonica Group	8	3
TOTAL DOMINANTS	214	80 15

SAPROBIC INDICES

Hilsenhoff Biotic Index	4.65

DIVERSITY MEASURES

Shannon H (loge)	2.41
Shannon H (log2)	3.48
Evenness	0.68
Simpson D	0.09

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	60	22.47
Univoltine	190	71.16
Semivoltine	17	6.37

	#TAXA	ABUNDANCE	PERCENT
Tolerant	6	66	24.72
Intolerant	2	9	3.37
Clinger	18	165	61.80

Aquatic Invertebrate Taxonomic Data

Site Name: Poison Creek
Site ID: P-1 6/18/01

Approx. percent of sample used: 100

Taxon	Quantity	Percent	HBI	FFG
Acentrella turbida	1	0.56	4	CG
Baetis tricaudatus	13	7.26	6	CG
Cinygmula sp.	71	39.66	4	SC
Epeorus longimanus	3	1.68	1	SC
Rhithrogena sp.	3	1.68	0	SC
Total Ephemeroptera	**91**	**50.84**		
Suwallia sp.	1	0.56	0	PR
Kogotus sp.	1	0.56	2	PR
Total Plecoptera	**2**	**1.12**		
Amiocentrus aspilus	1	0.56	3	CG
Brachycentrus americanus	20	11.17	1	OM
Micrasema sp.	5	2.79	1	MH
Helicopsyche borealis	1	0.56	7	SC
Rhyacophila Angelita Gr.	2	1.12	0	PR
Rhyacophila Brunnea Gr.	5	2.79	1	PR
Total Trichoptera	**34**	**18.99**		
Chelifera sp.	7	3.91	6	PR
Antocha sp.	2	1.12	3	CG
Hexatoma sp.	22	12.29	2	PR
Ormosia sp.	1	0.56	3	CG
Tipula sp.	2	1.12	4	OM
Total Diptera	**34**	**18.99**		
Corynoneura sp.	1	0.56	7	CG
Cricotopus nostococladius	2	1.12	3	PH
Eukiefferiella Devonica Gr	1	0.56	4	OM
Eukiefferiella Gracei Gr.	4	2.23	4	OM
Micropsectra sp.	3	1.68	7	CG
Orthocladius sp.	3	1.68	6	CG
Pagastia sp.	2	1.12	1	CG
Polypedilum sp.	1	0.56	6	OM
Tvetenia sp.	1	0.56	5	CG
Total Chironomidae	**18**	**10.06**		
Grand Total	**179**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Poison Creek **Site ID: P-1 6/18/01**

TOTAL ABUNDANCE	179
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	127
TOTAL NUMBER OF TAXA	27
Number EPT taxa	13

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc Taxa	0	0	0.00
Odonata	0	0	0.00
Ephemeroptera	5	91	50.84
Plecoptera	2	2	1.12
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	6	34	18.99
Lepidoptera	0	0	0.00
Coleoptera	0	0	0.00
Diptera	5	34	18.99
Chironomidae	9	18	10.06

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	7.06

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	6	38	21.23
Parasite	0	0	0.00
Collector-gatherer	10	28	15.64
Collector-filterer	0	0	0.00
Macrophyte-herbivore	1	5	2.79
Piercer-herbivore	1	2	1.12
Scraper	4	78	43.58
Shredder	0	0	0.00
Xylophage	0	0	0.00
Omnivore	5	28	15.64
Unknown	0	0	0.00

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	#DIV/0!
Scraper/(Scraper + C.filterer)	1.00
Shredder/Total organisms	0.00

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Cinygmula sp.	71	39.66
Hexatoma sp.	22	12.29
Brachycentrus americanus	20	11.17
Baetis tricaudatus	13	7.26
Chelifera sp.	7	3.91
SUBTOTAL 5 DOMINANTS	133	74.30
Micrasema sp.	5	2.79
Rhyacophila Brunnea Gr.	5	2.79
Eukiefferiella Gracei Gr.	4	2.23
Epeorus longimanus	3	1.68
Rhithrogena sp.	3	1.68
TOTAL DOMINANTS	153	85.48

SAPROBIC INDICES

Hilsenhoff Biotic Index	3.35

DIVERSITY MEASURES

Shannon H (loge)	2.29
Shannon H (log2)	3.30
Evenness	0.69
Simpson D	0.19

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	24	13.41
Univoltine	132	73.46
Semivoltine	24	13.13

	#TAXA	ABUNDANCE	PERCENT
Tolerant	2	14	7.82
Intolerant	2	3	1.68
Clinger	12	115	64.25

Aquatic Invertebrate Taxonomic Data

Site Name: Middle Fork Ruby River
Site ID: MF-5 6/12/01

Approx. percent of sample used: 100

Taxon	Quantity	Percent	HBI	FFG
Tubificidae - immature	7	2.72	9	CG
Sphaeriidae	4	1.56	8	CG
Total Misc. Taxa	**11**	**4.28**		
Acentrella turbida	34	13.23	4	CG
Baetis tricaudatus	2	0.78	6	CG
Drunella spinifera	1	0.39	0	PR
Ephemerella sp.	6	2.33	1	CG
Cinygmula sp.	16	6.23	4	SC
Epeorus albertae	6	2.33	1	SC
Epeorus longimanus	6	2.33	1	SC
Rhithrogena sp.	17	6.61	0	SC
Total Ephemeroptera	**88**	**34.24**		
Suwallia sp.	3	1.17	0	PR
Hesperoperla pacifica	1	0.39	2	PR
Isoperla sp.	1	0.39	2	PR
Total Plecoptera	**5**	**1.95**		
Amiocentrus aspilus	1	0.39	3	CG
Brachycentrus americanus	5	1.95	1	OM
Helicopsyche borealis	1	0.39	7	SC
Lepidostoma sp.-sand case larvae	6	2.33	1	SH
Neophylax sp.	1	0.39	3	SC
Total Trichoptera	**14**	**5.45**		
Optioservus sp.	11	4.28	4	SC
Zaitzevia sp.	23	8.95	4	CG
Total Coleoptera	**34**	**13.23**		
Atherix sp.	13	5.06	4	PR
Chelifera sp.	4	1.56	6	PR
Simulium sp.	35	13.62	6	CF
Antocha sp.	4	1.56	3	CG
Hexatoma sp.	2	0.78	2	PR
Hesperoconopa sp.	15	5.84	1	UN
Total Diptera	**73**	**28.40**		
Cricotopus Bicinctus Gr.	2	0.78	7	CG
Eukiefferiella Brehmi Gr.	8	3.11	4	OM
Micropsectra sp.	17	6.61	7	CG
Orthocladius sp.	5	1.95	6	CG
Total Chironomidae	**32**	**12.45**		
Grand Total	**257**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Middle Fork Ruby River **Site ID: MF-5 6/12/01**

TOTAL ABUNDANCE	257
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	107
TOTAL NUMBER OF TAXA	30
Number EPT taxa	16

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	2	11	4.28
Odonata	0	0	0.00
Ephemeroptera	8	88	34.24
Plecoptera	3	5	1.95
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	5	14	5.45
Lepidoptera	0	0	0.00
Coleoptera	2	34	13.23
Diptera	6	73	28.40
Chironomidae	4	32	12.45

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	3.34

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	7	25	9.73
Parasite	0	0	0.00
Collector-gatherer	11	105	40.86
Collector-filterer	1	35	13.62
Macrophyte-herbivore	0	0	0.00
Piercer-herbivore	0	0	0.00
Scraper	7	58	22.57
Shredder	1	6	2.33
Xylophage	0	0	0.00
Omnivore	2	13	5.06
Unknown	1	15	5.84

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	1.66
Scraper/(Scraper + C filterer)	0.62
Shredder/Total organisms	0.01

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Simulium sp.	35	13.62
Acentrella turbida	34	13.23
Zaitzevia sp.	23	8.95
Rhithrogena sp.	17	6.61
Micropsectra sp.	17	6.61
SUBTOTAL 5 DOMINANTS	126	49.03
Cinygmula sp.	16	6.23
Hesperoconopa sp.	15	5.84
Atherix sp.	13	5.06
Optioservus sp.	11	4.28
Eukiefferiella Brehmi Gr.	8	3.11
TOTAL DOMINANTS	189	73.54

SAPROBIC INDICES

Hilsenhoff Biotic Index	3.89

DIVERSITY MEASURES

Shannon H (loge)	2.58
Shannon H (log2)	3.72
Evenness	0.76
Simpson D	0.07

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	51	19.84
Univoltine	164	63.81
Semivoltine	42	16.34

	#TAXA	ABUNDANCE	PERCENT
Tolerant	4	37	14.40
Intolerant	1	15	5.84
Clinger	15	135	52.53

Aquatic Invertebrate Taxonomic Data

Site Name: E F Ruby River
Site ID: EF-1 6/19/01

Approx. percent of sample used: 100

Taxon	Quantity	Percent	HBI	FFG
Polycelis coronata	1	0.38	4	CG
Total Misc. Taxa	**1**	**0.38**		
Baetis tricaudatus	81	30.92	6	CG
Drunella coloradensis	6	2.29	0	CG
Drunella doddsi	3	1.15	0	CG
Drunella grandis	1	0.38	2	CG
Ephemerella inermis/infrequens	8	3.05	1	CG
Cinygmula sp.	42	16.03	4	SC
Epeorus longimanus	11	4.20	1	SC
Rhithrogena sp.	8	3.05	0	SC
Ameletus sp.	1	0.38	0	CG
Total Ephemeroptera	**161**	**61.45**		
Kogotus sp.	2	0.76	2	PR
Total Plecoptera	**2**	**0.76**		
Arctopsyche grandis	4	1.53	1	PR
Brachycentrus americanus	38	14.50	1	OM
Micrasema sp.	2	0.76	1	MH
Glossosoma sp.	2	0.76	1	SC
Lepidostoma sp.-sand case larvae	9	3.44	1	SH
Apatania sp.	2	0.76	1	SC
Rhyacophila Angelita Gr.	3	1.15	0	PR
Rhyacophila Brunnea Gr.	4	1.53	1	PR
Total Trichoptera	**64**	**24.43**		
Antocha sp.	6	2.29	3	CG
Hexatoma sp.	15	5.73	2	PR
Tipula sp.	1	0.38	4	OM
Total Diptera	**22**	**8.40**		
Eukiefferiella Gracei Gr.	6	2.29	4	OM
Orthocladius sp.	3	1.15	6	CG
Pagastia sp.	1	0.38	1	CG
Tvetenia sp.	2	0.76	5	CG
Total Chironomidae	**12**	**4.58**		
Grand Total	**262** ✓	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: E F Ruby River **Site ID: EF-1 6/19/01**

TOTAL ABUNDANCE	262
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	227
TOTAL NUMBER OF TAXA	26
Number EPT taxa	18

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	1	1	0.38
Odonata	0	0	0.00
Ephemeroptera	9	161	61.45
Plecoptera	1	2	0.76
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	8	64	24.43
Lepidoptera	0	0	0.00
Coleoptera	0	0	0.00
Diptera	3	22	8.40
Chironomidae	4	12	4.58

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	18.92

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	5	28	10.69
Parasite	0	0	0.00
Collector-gatherer	11	113	43.13
Collector-filterer	0	0	0.00
Macrophyte-herbivore	1	2	0.76
Piercer-herbivore	0	0	0.00
Scraper	5	65	24.81
Shredder	1	9	3.44
Xylophage	0	0	0.00
Omnivore	3	45	17.18
Unknown	0	0	0.00

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	#DIV/0!
Scraper/(Scraper + C.filterer)	1.00
Shredder/Total organisms	0.01

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Baetis tricaudatus	81	30.92
Cinygmula sp.	42	16.03
Brachycentrus americanus	38	14.50
Hexatoma sp.	15	5.73
Epeorus longimanus	11	4.20
SUBTOTAL 5 DOMINANTS	187	71.37
Lepidostoma sp.-sand case larv.	9	3.44
Ephemerella inermis/infrequens	8	3.05
Rhithrogena sp.	8	3.05
Drunella coloradensis	6	2.29
Antocha sp.	6	2.29
TOTAL DOMINANTS	224	85.5

SAPROBIC INDICES

Hilsenhoff Biotic Index	3.24

DIVERSITY MEASURES

Shannon H (loge)	2.40
Shannon H (log2)	3.46
Evenness	0.74
Simpson D	0.15

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	71	27.00
Univoltine	146	55.63
Semivoltine	46	17.37

	#TAXA	ABUNDANCE	PERCENT
Tolerant	1	81	30.92
Intolerant	2	4	1.53
Clinger	16	142	54.20

Aquatic Invertebrate Taxonomic Data

Site Name: E F Ruby River
Site ID: EF-2 6/16/01

Approx. percent of sample used: 67

Taxon	Quantity	Percent	HBI	FFG
Acentrella insignificans	40	11.63	4	CG
Baetis tricaudatus	50	14.53	6	CG
Drunella coloradensis	2	0.58	0	CG
Drunella doddsi	3	0.87	0	CG
Ephemerella infrequens	6	1.74	1	SH
Cinygmula sp.	50	14.53	4	SC
Epeorus longimanus	11	3.20	1	SC
Rhithrogena sp.	4	1.16	0	SC
Ameletus sp.	1	0.29	0	CG
Total Ephemeroptera	**167**	**48.55**		
Brachycentrus americanus	72	20.93	1	OM
Micrasema sp.	1	0.29	1	MH
Lepidostoma sp.-sand case larvae	35	10.17	1	SH
Ecclisomyia sp.	1	0.29	2	OM
Rhyacophila Brunnea Gr.	1	0.29	1	PR
Rhyacophila pellisa	2	0.58	1	PR
Neophylax occidentis	27	7.85	1	SC
Total Trichoptera	**139**	**40.41**		
Atherix sp.	2	0.58	4	PR
Ceratopogoninae	2	0.58	6	PR
Antocha sp.	4	1.16	3	CG
Hexatoma sp.	26	7.56	2	PR
Hesperoconopa sp.	1	0.29	1	UN
Total Diptera	**35**	**10.17**		
Eukiefferiella Brehmi Gr.	2	0.58	4	OM
Orthocladius sp.	1	0.29	6	CG
Total Chironomidae	**3**	**0.87**		
Grand Total	**344**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: E F Ruby River **Site ID: EF-2 6/16/01**

TOTAL ABUNDANCE	344
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	306
TOTAL NUMBER OF TAXA	23
Number EPT taxa	16

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	0	0	0.00
Odonata	0	0	0.00
Ephemeroptera	9	167	48.55
Plecoptera	0	0	0.00
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	7	139	40.41
Lepidoptera	0	0	0.00
Coleoptera	0	0	0.00
Diptera	5	35	10.17
Chironomidae	2	3	0.87

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	102.00

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	5	33	9.59
Parasite	0	0	0.00
Collector-gatherer	7	101	29.36
Collector-filterer	0	0	0.00
Macrophyte-herbivore	1	1	0.29
Piercer-herbivore	0	0	0.00
Scraper	4	92	26.74
Shredder	2	41	11.92
Xylophage	0	0	0.00
Omnivore	3	75	21.80
Unknown	1	1	0.29

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	#DIV/0!
Scraper/(Scraper + C.filterer)	1.00
Shredder/Total organisms	0.03

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Brachycentrus americanus	72	20.93
Baetis tricaudatus	50	14.53
Cinygmula sp.	50	14.53
Acentrella insignificans	40	11.63
Lepidostoma sp.-sand case larv.	35	10.17
SUBTOTAL 5 DOMINANTS	247	71.80
Neophylax occidentis	27	7.85
Hexatoma sp.	26	7.56
Epeorus longimanus	11	3.20
Ephemerella infrequens	6	1.74
Rhithrogena sp.	4	1.16
TOTAL DOMINANTS	321	93.31

SAPROBIC INDICES

Hilsenhoff Biotic Index	2.66

DIVERSITY MEASURES

Shannon H (loge)	2.34
Shannon H (log2)	3.38
Evenness	0.75
Simpson D	#DIV/0!

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	70	20.28
Univoltine	201	58.36
Semivoltine	74	21.37

	#TAXA	ABUNDANCE	PERCENT
Tolerant	1	50	14.53
Intolerant	3	29	8.43
Clinger	13	184	53.49

Aquatic Invertebrate Taxonomic Data

Site Name: Burnt Creek
Site ID: B-1 6/19/01

Approx. percent of sample used: 100

Taxon	Quantity	Percent	HBI	FFG
Baetis tricaudatus	62	43.36	6	CG
Drunella coloradensis	9	6.29	0	CG
Drunella doddsi	10	6.99	0	CG
Drunella spinifera	1	0.70	0	PR
Ephemerella sp.	1	0.70	1	CG
Cinygmula sp.	4	2.80	4	SC
Epeorus longimanus	11	7.69	1	SC
Epeorus grandis	2	1.40	0	SC
Rhithrogena sp.	1	0.70	0	SC
Total Ephemeroptera	**101**	**70.63**		
Hesperoperla pacifica	3	2.10	2	PR
Total Plecoptera	**3**	**2.10**		
Micrasema sp.	1	0.70	1	MH
Glossosoma sp.	2	1.40	1	SC
Rhyacophila Angelita Gr.	1	0.70	0	PR
Rhyacophila Brunnea Gr.	12	8.39	1	PR
Total Trichoptera	**16**	**11.19**		
Dytiscidae - larvae	1	0.70	5	PR
Heterlimnius sp.	5	3.50	4	CG
Total Coleoptera	**6**	**4.20**		
Pericoma sp.	1	0.70	4	CG
Simulium sp.	3	2.10	6	CF
Total Diptera	**4**	**2.80**		
Corynoneura sp.	2	1.40	7	CG
Cricotopus (Isocladius) Gr.	6	4.20	7	CG
Orthocladius sp.	5	3.50	6	CG
Total Chironomidae	**13**	**9.09**		
Grand Total	**143**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Burnt Creek **Site ID: B-1 6/19/01**

TOTAL ABUNDANCE	143
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	120
TOTAL NUMBER OF TAXA	21
Number EPT taxa	14

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	0	0	0.00
Odonata	0	0	0.00
Ephemeroptera	9	101	70.63
Plecoptera	1	3	2.10
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	4	16	11.19
Lepidoptera	0	0	0.00
Coleoptera	2	6	4.20
Diptera	2	4	2.80
Chironomidae	3	13	9.09

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	9.23

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	5	18	12.59
Parasite	0	0	0.00
Collector-gatherer	9	101	70.63
Collector-filterer	1	3	2.10
Macrophyte-herbivore	1	1	0.70
Piercer-herbivore	0	0	0.00
Scraper	5	20	13.99
Shredder	0	0	0.00
Xylophage	0	0	0.00
Omnivore	0	0	0.00
Unknown	0	0	0.00

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	6.67
Scraper/(Scraper + C.filterer)	0.87
Shredder/Total organisms	0.00

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Baetis tricaudatus	62	43.36
Rhyacophila Brunnea Gr	12	8.39
Epeorus longimanus	11	7.69
Drunella doddsi	10	6.99
Drunella coloradensis	9	6.29
SUBTOTAL 5 DOMINANTS	104	72.73
Cricotopus (Isocladius) Gr.	6	4.20
Heterlimnius sp.	5	3.50
Orthocladius sp.	5	3.50
Cinygmula sp.	4	2.80
Hesperoperla pacifica	3	2.10
TOTAL DOMINANTS	127	88.81

SAPROBIC INDICES

Hilsenhoff Biotic Index	3.87

DIVERSITY MEASURES

Shannon H (loge)	2.18
Shannon H (log2)	3.14
Evenness	0.72
Simpson D	0.21

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	56	39.34
Univoltine	71	49.83
Semivoltine	16	10.84

	#TAXA	ABUNDANCE	PERCENT
Tolerant	2	63	44.06
Intolerant	1	2	1.40
Clinger	15	69	48.25

Aquatic Invertebrate Taxonomic Data

Site Name: Burnt Creek
Site ID: B-2 6/19/01

Approx. percent of sample used: 50

Taxon	Quantity	Percent	HBI	FFG
Polycelis coronata	2	0.61	4	CG
Total Misc. Taxa	**2**	**0.61**		
Baetis tricaudatus	178	54.60	6	CG
Ephemerella sp.	8	2.45	1	CG
Cinygmula sp.	19	5.83	4	SC
Epeorus longimanus	11	3.37	1	SC
Rhithrogena sp.	2	0.61	0	SC
Ameletus sp.	1	0.31	0	CG
Total Ephemeroptera	**219**	**67.18**		
Hesperoperla pacifica	2	0.61	2	PR
Kogotus sp.	6	1.84	2	PR
Total Plecoptera	**8**	**2.45**		
Brachycentrus americanus	2	0.61	1	OM
Micrasema sp.	2	0.61	1	MH
Helicopsyche borealis	1	0.31	7	SC
Ochrotrichia sp.	1	0.31	4	PH
Rhyacophila Angelita Gr	1	0.31	0	PR
Rhyacophila Brunnea Gr.	6	1.84	1	PR
Total Trichoptera	**13**	**3.99**		
Oreodytes sp.	3	0.92	5	PR
Cleptelmis sp.	1	0.31	4	CG
Heterlimnius sp.	6	1.84	4	CG
Total Coleoptera	**10**	**3.07**		
Ceratopogoninae	2	0.61	6	PR
Chelifera sp.	1	0.31	6	PR
Pericoma sp.	2	0.61	4	CG
Simulium sp.	4	1.23	6	CF
Caloparyphus sp	1	0.31	5	CG
Antocha sp.	5	1.53	3	CG
Hexatoma sp.	1	0.31	2	PR
Total Diptera	**16**	**4.91**		
Cricotopus nostococladius	4	1.23	3	PH
Eukiefferiella Devonica Gr.	24	7.36	4	OM
Eukiefferiella Gracei Gr.	1	0.31	4	OM
Microtendipes sp.	1	0.31	6	CG
Orthocladius sp.	25	7.67	6	CG
Parametriocnemus sp.	2	0.61	5	CG
Stempellinella sp.	1	0.31	4	UN
Total Chironomidae	**58**	**17.79**		
Grand Total	**326**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Burnt Creek **Site ID: B-2 6/19/01**

TOTAL ABUNDANCE	326
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	240
TOTAL NUMBER OF TAXA	32
Number EPT taxa	14

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	1	2	0.61
Odonata	0	0	0.00
Ephemeroptera	6	219	67.18
Plecoptera	2	8	2.45
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	6	13	3.99
Lepidoptera	0	0	0.00
Coleoptera	3	10	3.07
Diptera	7	16	4 91
Chironomidae	7	58	17.79

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	4 14

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	8	22	6 75
Parasite	0	0	0.00
Collector-gatherer	12	232	71 17
Collector-filterer	1	4	1 23
Macrophyte-herbivore	1	2	0 61
Piercer-herbivore	2	5	1 53
Scraper	4	33	10.12
Shredder	0	0	0.00
Xylophage	0	0	0.00
Omnivore	3	27	8.28
Unknown	1	1	0.31

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	8.25
Scraper/(Scraper + C.filterer)	0.89
Shredder/Total organisms	0.00

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Baetis tricaudatus	178	54.60
Orthocladius sp.	25	7.67
Eukiefferiella Devonica Gr	24	7.36
Cinygmula sp.	19	5.83
Epeorus longimanus	11	3.37
SUBTOTAL 5 DOMINANTS	257	78.83
Ephemerella sp.	8	2.45
Kogotus sp.	6	1.84
Rhyacophila Brunnea Gr.	6	1.84
Heterlimnius sp.	6	1.84
Antocha sp.	5	1.53
TOTAL DOMINANTS	288	88.34

SAPROBIC INDICES

Hilsenhoff Biotic Index	4.92

DIVERSITY MEASURES

Shannon H (loge)	1.61
Shannon H (log2)	2.33
Evenness	0.47
Simpson D	0.26

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	180	55.14
Univoltine	129	39.49
Semivoltine	18	5.37

	#TAXA	ABUNDANCE	PERCENT
Tolerant	6	185	56.75
Intolerant	2	10	3.07
Clinger	15	75	23.01

Aquatic Invertebrate Taxonomic Data

Site Name: Sweetwater Creek
Site ID: S-1 6/1/01

Approx. percent of sample used: 27

Taxon	Quantity	Percent	HBI	FFG
Nais sp.	1	0.33	8	CG
Tubificidae - immature	4	1.32	9	CG
Sphaeriidae	8	2.65	8	CG
Fossaria sp.	4	1.32	6	CG
Acari	2	0.66	5	PA
Total Misc. Taxa	**19**	**6.29**		
Acentrella insignificans	16	5.30	4	CG
Baetis tricaudatus	3	0.99	6	CG
Labiobaetis sp.	3	0.99	4	CG
Ephemerella inermis	2	0.66	1	CG
Total Ephemeroptera	**24**	**7.95**		
Brachycentrus americanus	3	0.99	1	OM
Micrasema sp.	1	0.33	1	MH
Glossosoma sp.	1	0.33	1	SC
Helicopsyche borealis	5	1.66	7	SC
Hydropsyche sp.	3	0.99	4	CF
Lepidostoma sp.-sand case larvae	4	1.32	1	SH
Wormaldia sp.	1	0.33	3	CF
Rhyacophila Angelita Gr.	1	0.33	0	PR
Rhyacophila Brunnea Gr.	2	0.66	1	PR
Total Trichoptera	**21**	**6.95**		
Dytiscidae	1	0.33	5	PR
Optioservus sp.	30	9.93	4	SC
Zaitzevia sp.	11	3.64	4	CG
Total Coleoptera	**42**	**13.91**		
Ceratopogoninae	1	0.33	6	PR
Chelifera sp.	2	0.66	6	PR
Antocha sp.	12	3.97	3	CG
Hexatoma sp.	2	0.66	2	PR
Limnophila sp.	1	0.33	6	MH
Total Diptera	**18**	**5.96**		
Corynoneura sp.	1	0.33	7	CG
Eukiefferiella Brehmi Gr.	1	0.33	4	OM
Eukiefferiella Pseudomontana Gr.	22	7.28	8	OM
Heterotrissocladius sp.	3	0.99	0	CG
Micropsectra sp.	10	3.31	7	CG
Orthocladius sp.	49	16.23	6	CG
Pagastia sp	40	13.25	1	CG
Parametriocnemus sp.	1	0.33	5	CG
Thienemanniella sp.	40	13.25	6	CG
Thienemannimyia Gr.	8	2.65	6	PR
Tvetenia sp.	3	0.99	5	CG
Total Chironomidae	**178**	**58.94**		
Grand Total	**302**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Sweetwater Creek **Site ID: S-1 6/1/01**

TOTAL ABUNDANCE	302
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	45
TOTAL NUMBER OF TAXA	37
Number EPT taxa	13

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	5	19	6.29
Odonata	0	0	0.00
Ephemeroptera	4	24	7.95
Plecoptera	0	0	0.00
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	9	21	6.95
Lepidoptera	0	0	0.00
Coleoptera	3	42	13.91
Diptera	5	18	5.96
Chironomidae	11	178	58.94

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	0.25

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	7	17	5.63
Parasite	1	2	0.66
Collector-gatherer	18	211	69.87
Collector-filterer	2	4	1.32
Macrophyte-herbivore	2	2	0.66
Piercer-herbivore	0	0	0.00
Scraper	3	36	11.92
Shredder	1	4	1.32
Xylophage	0	0	0.00
Omnivore	3	26	8.61
Unknown	0	0	0.00

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	9.00
Scraper/(Scraper + C.filterer)	0.90
Shredder/Total organisms	0.00

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Orthocladius sp.	49	16.23
Pagastia sp.	40	13.25
Thienemanniella sp.	40	13.25
Optioservus sp.	30	9.93
Eukiefferiella Pseudomontana C	22	7.28
SUBTOTAL 5 DOMINANTS	181	59.93
Acentrella insignificans	16	5.30
Antocha sp.	12	3.97
Zaitzevia sp.	11	3.64
Micropsectra sp.	10	3.31
Sphaeriidae	8	2.65
TOTAL DOMINANTS	238	78.81

SAPROBIC INDICES

Hilsenhoff Biotic Index	4.74

DIVERSITY MEASURES

Shannon H (loge)	2.85
Shannon H (log2)	4.11
Evenness	0.79
Simpson D	0.08

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	153	50.58
Univoltine	99	32.70
Semivoltine	51	16.72

	#TAXA	ABUNDANCE	PERCENT
Tolerant	8	77	25.50
Intolerant	1	3	0.99
Clinger	12	72	23.84

Aquatic Invertebrate Taxonomic Data

Site Name: Sweetwater Creek
Site ID: S-4 6/1/01

Approx. percent of sample used: 100

Taxon	Quantity	Percent	HBI	FFG
Eiseniella tetraedra	8	2.57	8	CG
Total Misc. Taxa	**8**	**2.57**		
Baetis tricaudatus	4	1.29	6	CG
Total Ephemeroptera	**4**	**1.29**		
Alloperla sp.	1	0.32	0	PR
Total Plecoptera	**1**	**0.32**		
Dytiscidae-larvae	3	0.96	5	PR
Optioservus sp.	1	0.32	4	SC
Total Coleoptera	**4**	**1.29**		
Simulium sp.	21	6.75	6	CF
Dicranota sp.	1	0.32	3	PR
Total Diptera	**22**	**7.07**		
Corynoneura sp.	16	5.14	7	CG
Cricotopus (Isocladius) Gr.	2	0.64	7	CG
Eukiefferiella Gracei Gr.	2	0.64	4	OM
Micropsectra sp.	3	0.96	7	CG
Orthocladius sp.	210	67.52	6	CG
Pagastia sp.	1	0.32	1	CG
Parametriocnemus sp.	6	1.93	5	CG
Thienemanniella sp.	4	1.29	6	CG
Thienemannimyia Gr.	5	1.61	6	PR
Tvetenia sp.	23	7.40	5	CG
Total Chironomidae	**272**	**87.46**		
Grand Total	**311**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Sweetwater Creek **Site ID: S-4 6/1/01**

TOTAL ABUNDANCE	311
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	5
TOTAL NUMBER OF TAXA	17
Number EPT taxa	2

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	1	8	2.57
Odonata	0	0	0.00
Ephemeroptera	1	4	1.29
Plecoptera	1	1	0.32
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	0	0	0.00
Lepidoptera	0	0	0.00
Coleoptera	2	4	1.29
Diptera	2	22	7.07
Chironomidae	10	272	87.46

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	0.02

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	4	10	3.22
Parasite	0	0	0.00
Collector-gatherer	10	277	89.07
Collector-filterer	1	21	6.75
Macrophyte-herbivore	0	0	0.00
Piercer-herbivore	0	0	0.00
Scraper	1	1	0.32
Shredder	0	0	0.00
Xylophage	0	0	0.00
Omnivore	1	2	0.64
Unknown	0	0	0.00

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	0.05
Scraper/(Scraper + C.filterer)	0.05
Shredder/Total organisms	0.00

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Orthocladius sp.	210	67.52
Tvetenia sp	23	7.40
Simulium sp.	21	6.75
Corynoneura sp.	16	5.14
Eiseniella tetraedra	8	2.57
SUBTOTAL 5 DOMINANTS	278	89.39
Parametriocnemus sp.	6	1.93
Thienemanniimyia Gr	5	1.61
Baetis tricaudatus	4	1.29
Thienemanniella sp.	4	1.29
Dytiscidae	3	0.96
TOTAL DOMINANTS	300	96.47

SAPROBIC INDICES

Hilsenhoff Biotic Index	5.95

DIVERSITY MEASURES

Shannon H (loge)	1.37
Shannon H (log2)	1.98
Evenness	0.48
Simpson D	0.47

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	207	66.56
Univoltine	100	32.15
Semivoltine	4	1.29

	#TAXA	ABUNDANCE	PERCENT
Tolerant	3	8	2.57
Intolerant	0	0	0.00
Clinger	3	24	7.72

Aquatic Invertebrate Taxonomic Data

Site Name: Cottonwood Creek
Site ID: C-3 5/31/01

Approx. percent of sample used: 100

Taxon	Quantity	Percent	HBI	FFG
Baetis tricaudatus	22	24.18	6	CG
Drunella coloradensis	13	14.29	0	CG
Cinygmula sp.	2	2.20	4	SC
Total Ephemeroptera	**37**	**40.66**		
Kathroperla perdita	1	1.10	0	PR
Sweltsa sp.	1	1.10	1	PR
Perlodidae-early instar	1	1.10	2	PR
Total Plecoptera	**3**	**3.30**		
Rhyacophila Brunnea Gr.	4	4.40	1	PR
Total Trichoptera	**4**	**4.40**		
Heterlimnius sp.	40	43.96	4	CG
Optioservus sp.	1	1.10	4	SC
Total Coleoptera	**41**	**45.05**		
Hesperoconopa sp.	5	5.49	1	UN
Total Diptera	**5**	**5.49**		
Parametriocnemus sp.	1	1.10	5	CG
Total Chironomidae	**1**	**1.10**		
Grand Total	**91**	**100.00**		

Aquatic Invertebrate Summary Data

Site Name: Cottonwood Creek **Site ID: C-3 5/31/01**

TOTAL ABUNDANCE	91
Ephemeroptera + Plecoptera + Trichoptera (EPT) abundance	44
TOTAL NUMBER OF TAXA	11
Number EPT taxa	7

TAXONOMIC GROUP COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Misc. Taxa	0	0	0.00
Odonata	0	0	0.00
Ephemeroptera	3	37	40.66
Plecoptera	3	3	3.30
Hemiptera	0	0	0.00
Megaloptera	0	0	0.00
Trichoptera	1	4	4.40
Lepidoptera	0	0	0.00
Coleoptera	2	41	45.05
Diptera	1	5	5.49
Chironomidae	1	1	1.10

RATIOS OF TAX GROUP ABUNDANCES

EPT/Chironomidae	44.00

FUNCTIONAL FEEDING GROUP (FFG) COMPOSITION

GROUP	#TAXA	ABUNDAN	PERCENT
Predator	4	7	7.69
Parasite	0	0	0.00
Collector-gatherer	4	76	83.52
Collector-filterer	0	0	0.00
Macrophyte-herbivore	0	0	0.00
Piercer-herbivore	0	0	0.00
Scraper	2	3	3.30
Shredder	0	0	0.00
Xylophage	0	0	0.00
Omnivore	0	0	0.00
Unknown	1	5	5.49

RATIOS OF FFG ABUNDANCES

Scraper/Collector-filterer	#DIV/0!
Scraper/(Scraper + C.filterer)	1.00
Shredder/Total organisms	0.00

CONTRIBUTION OF DOMINANT TAXA

TAXON	ABUNDANCE	PERCENT
Heterlimnius sp.	40	43.96
Baetis tricaudatus	22	24.18
Drunella coloradensis	13	14.29
Hesperoconopa sp.	5	5.49
Rhyacophila Brunnea Gr.	4	4.40
SUBTOTAL 5 DOMINANTS	84	92.31
Cinygmula sp.	2	2.20
Kathroperla perdita	1	1.10
Sweltsa sp.	1	1.10
TOTAL DOMINANTS	88	96.70

SAPROBIC INDICES

Hilsenhoff Biotic Index	3.53

DIVERSITY MEASURES

Shannon H (loge)	1.61
Shannon H (log2)	2.32
Evenness	0.67
Simpson D	0.27

COMMUNITY VOLTINISM ANALYSIS

TYPE	ABUNDANCE	PERCENT
Multivoltine	17	18.96
Univoltine	31	33.79
Semivoltine	43	47.25

	#TAXA	ABUNDANCE	PERCENT
Tolerant	2	23	25.27
Intolerant	2	6	6.59
Clinger	6	61	67.03

Macroinvertebrate Bioass ;ment using MDEQ's 1998 Interm tain Valley and Foothill Ecoregion Criteria

Waterbody(s):	**Addendum Prepared by Alan Nixon 01/24/02**

Burnt Creek (Tributary to the Upper Ruby River)

Table 1. Benthic macroinvertebrate metric analysis.

Site:	Bur-1	Bur-2			
Date:	5/25/2001	5/25/2001			
Taxa Richness	21	32			
EPT Richness	14	14			
Biotic Index	3.870	4.9200			
% Dominant Taxon	43.36	54.6			
% Collectors (g+ff)	72.73	72.4			
% Scrapers and Shredders	13.99	10.12			
% Hydropsychinae of Trichoptera	0	0			
% EPT	83.9	73.6			

Table 2. Benthic macroinvertebrate data scoring using MDEQ's Intermountain Valley and Foothill Ecoregion criteria.

Site:	Bur-1	Bur-2			
Taxa Richness	1	3			
EPT Richness	2	2			
Biotic Index	2	2			
% Dominant Taxon	1	0			
% Collectors (g+ff)	3	3			
% Scrapers and Shredders	1	1			
% Hydropsychinae of Trichoptera	0	0			
% EPT	3	3			
Totals	13	14	0	0	0
Scored percentages	54.2	58.3	0.0	0.0	0.0